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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/607,580	06/29/2000	Youfeng Wu	042390.R8653	9087

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EXAMINER

HARKNESS, CHARLES A

ART UNIT	PAPER NUMBER
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2183

DATE MAILED: 02/24/2004

6

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/607,580

Applicant(s)

WU ET AL.

Examiner

Charles A Harkness

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 06 October 2003 and 08 December 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-4,6-8,10-15,17,18,20,21,24-27,29 and 30 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4,6-8,10-15,17,18,20,21,24-27,29 and 30 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

1. In view of Applicant's amendment to the title the objection has been withdrawn.

#### ***Claim Objections***

2. Claim 10 is objected to because of the following informalities: Claim 10 is objected to for being dependent on a claim that has been withdrawn. For the purpose of this Office Action, it will be assumed that claim 10 is dependent on claim 8. Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3, 10-11, 13-14, 18, 20, and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Exploiting Basic Block Value Locality with Block Reuse", Huang et al. (herein referred to as Huang).

4. Referring to claims 1, 8, 18, and 24 Huang has taught a system for speculatively reusing regions of code, the system comprising:

a memory to store regions of code (Huang abstract lines 8-10, 13-15); and

a processor, coupled to the memory, identifying a reuse region and input data of the reuse region (Huang abstract, page 1 column 2 paragraphs 2 and 3, page 2);

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searching a plurality of instances of the reuse region for a valid matching instance that has matching input data and cannot be potentially invalidated (Huang abstract, page 1 column 2 paragraphs 2 and 3, page 2);

if the valid matching instance is not found, predicting, for the reuse region, a current set of live-out vales (Huang page 1, paragraph 2, last 2 sentences; page 5 first two sentences; the block history buffer is used for both block reuse and prediction, so block reuse supplements prediction, and does not replace it according to Huang). Huang has not taught predicting, for the reuse region, a current set of live-out vales using reuse region instance information pertaining to the plurality of instances of the reuse region. However, one of ordinary skill in the art at the time of the invention would have recognized the benefit in using the plurality of instances for a basic blocks of code that have been previously executed to predict the data values that will be produced for that basic block when it has different input values. Since Huang has already taught predicting instruction outputs, one of ordinary skill in the art at the time of the invention, would have recognized that using the input values and output values of the instances in the block reuse buffer would give a better prediction than a "blind" guess. Huang teaches how different prediction methods are used to predict at the instruction level (Huang page 1, column 2 paragraph 1). So even though not every input combination will be recorded for every reuse block of instructions in the block history buffer, one would see the benefit in predicting what the output would be for the present block if its input combination has not been executed before, to try and produce the answers faster than waiting for the processor to execute the instructions in the block. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to predicting, for the reuse region, a current set of live-out vales using reuse region

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instance information pertaining to the plurality of instances of the reuse region to produce a better prediction which would speed up the execution of the instructions and thus the program as a whole.

5. Referring to claims 2 and 25 Huang has taught wherein searching the plurality of instances of the reuse region comprises:

determining whether the input data of the reuse region matches any input information within the reuse region instance information and if the input data matches input information within the reuse region information, determining whether the reuse region is identified by a normal reuse instruction (Huang abstract, page 2 column 1).

6. Referring to claims 3, 20, and 26 Huang has taught wherein the reuse region instance information includes input information and output information for each instance of the reuse region (Huang abstract, page 2 column 1).

7. Referring to claim 13 Huang has not taught wherein the buffer includes a prediction list having a plurality of pointers to reuse region instances held in the buffer, a pointer to the most currently used instance being located on the top of the prediction list and a pointer to the least currently used instance being located at the bottom of the prediction list. (Huang abstract, pages 1 and 2; it is inherent that the buffer would have to be sorted in some manner to allow the system to search for particular entries for certain blocks of code). Official Notice is taken, that one of ordinary skill in the art at the time of the invention would have recognized that the buffer could be used as a list, which would use pointers to show the different entries in the list.

8. Referring to claim 14 Huang has not taught wherein the buffer includes a value prediction table having an entry that includes a predicted output value, the predicted output value being

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located using an index. Huang has taught where the indexing is done by the address of the first instruction in the instruction block (Huang page 3 column 2 paragraph 2). Since there appears to be no certain benefit of indexing using the output value over indexing using the instruction address of the first instruction in the block, it is simply a design choice, and is not necessarily patentable. One of ordinary skill in the art at the time of the invention would recognize that the buffer, or list, would have to be indexed by some means or value located in the list, and by choosing a value that is in the list, the system can find all the entries for a particular output value. It would have been obvious to one of ordinary skill in the art at the time of the invention to use an index of some value in the list, including the output value of the block, and that using a particular value over another is a design choice.

9. Referring to claim 10 Huang has taught wherein the processing core is to search the buffer for a valid matching instance by finding an instance with input data matching the current input data of the reuse region and determining whether the reuse region is identified by a normal reuse instruction (Huang abstract, page 1 column 2 paragraphs 2 and 3, page 2 column 1).

10. Referring to claim 11 Huang has taught wherein the reuse region instance information includes input information and output information for each instance of the reuse region (Huang abstract, page 1 column 2 paragraphs 2 and 3, page 2 column 1).

11. Claims 4, 6-7, 12, 17, 21, 27, and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang in view of Kulkarni et al, U.S. Patent Number 5,742,805 (herein referred to as Kulkarni).

12. Referring to claims 4, 12, 21, and 27 Huang has not explicitly taught wherein the reuse region instance information further includes a plurality of confidence counters for each live-out

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register of the reuse region, each of the plurality of confidence counters being associated with a prediction technique. However, using a counter to show the accuracy of prediction is well known in the art. Kulkarni has taught using a confidence counter to show the accuracy in a prediction for an instruction (Kulkarni column 2 lines 39-47). Using a counter to show how accurate the prediction for an instruction, or a group of instructions, will allow the system to predict when the accuracy is high, and to not predict and just to continue to execute when the prediction accuracy is low. This will prevent the system from having many mispredictions, which are costly to the system in terms of time lost. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention would use an accuracy counter for predictions for instructions to prevent having some mispredictions which slow the system down, thus reducing the time for execution.

13. Referring to claims 6, 15, and 29 Huang has taught wherein predicting an output value for each live out register further comprises selecting the at least one prediction technique from multiple prediction techniques (Huang abstract page 1 columns 1 and 2, page 2 column 1; page 1 column 2 paragraph 1).

Huang has not explicitly taught wherein predicting the current set of live-out values further comprises comparing a plurality of confidence counters associated with said each live-out register, selecting an optimal prediction technique for said each live-out register based on comparison and selecting the output value for said each live-out register using the optimal prediction technique. However, using a counter to show the accuracy of prediction is well known in the art. Kulkarni has taught using a confidence counter to show the accuracy in a prediction for an instruction (Kulkarni column 2 lines 39-47). Using a counter to show how accurate the

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prediction for an instruction, or a group of instructions, will allow the system to predict when the accuracy is high, and to not predict and just to continue to execute when the prediction accuracy is low. This will prevent the system from having many mispredictions, which are costly to the system in terms of time lost. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention would use an accuracy counter for predictions for instructions to prevent having some mispredictions which slow the system down, thus reducing the time for execution.

14. Referring to claims 7, 17, and 30 Huang has taught wherein the optimal prediction technique is any of a context-based prediction technique, a stride prediction technique, and a last value prediction technique (Huang page 1 column 2 paragraph 1).

***Response to Arguments***

15. Applicant's arguments filed 12/08/03 have been fully considered but they are not persuasive.

16. Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

17. In addition, Huang has taught where the block history buffer is used for both block reuse and prediction; therefore the block reuse supplements prediction, and does not replace it according to Huang (Huang page 1, paragraph 2, last 2 sentences; page 5 first two sentences).

Although Huang has not taught the details of predicting for the basic block of instructions, one of ordinary skill in the art at the time of the invention would have recognized the benefit in using the plurality of instances for a basic blocks of code that have been previously executed to predict

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the data values that will be produced for that basic block when it has different input values. Since Huang has already taught predicting instruction outputs, one of ordinary skill in the art at the time of the invention, would have recognized that using the input values and output values of the instances in the block reuse buffer would give a better prediction than a "blind" guess.

### *Conclusion*

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles A Harkness whose telephone number is 703-305-7579. The examiner can normally be reached on 8:00 A.M. – 5:00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on 703-305-9712. The fax phone numbers for the organization where this application or proceeding is assigned are 703-746-7239 for regular communications and 703-746-7238 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-7579.

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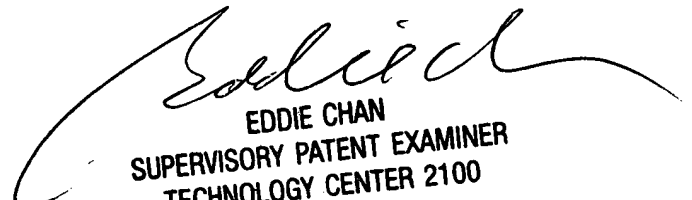
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Charles Allen Harkness

Examiner

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February 20, 2004



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